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Salix babylonica

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THE ASSOCIATES, through whose interest and generosity *The Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum.

CLASSES OF MEMBERSHIP

Contributing	$ 5.00 a year	Supporting	$ 25.00 a year
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Arboretum Activities

OUR ASSOCIATES

As indicated on our masthead, the group of Associates of the Morris Arboretum is composed of people interested in supporting our manifold activities.

First created in the 1930's, this body of loyal friends made possible the appearance of the initial volume of our Bulletin, which was issued in 1935, and has supported its publication ever since.

For more than twenty years the number of our Associates remained between 80 and 90 and the annual dues were fixed at $10.00. In the Spring of 1955 there came into existence our Advisory Council under the able Chairmanship of Mrs. E. Florens Rivinus. One of the first matters to receive the attention of this Council was the desirability of increasing the number of Arboretum Associates. Each member of the Council sub-

(Continued on Page 13)

The Weeping Willow and Lombardy Poplar

HUI-LIN LI

The Weeping Willow and Lombardy Poplar are two of the most widely planted trees in the world. In appearance, few trees show such extreme contrasts, broad, rounded, with drooping branches in one and narrow, pyramidal, with strongly fastigiate branches in the other. (See Cover and Figs. 1, 2, 4, and 5) [1]. Yet the two are closely related members of a distinct family, one being in the genus *Salix* and the other in *Populus*, the only two genera of the phylogenetically very much isolated family Salicaceae. Thus, in spite of their extreme outward differences, the two trees are near relatives, sharing between them a common genealogy and heritage.

The origins of cultivation of both trees are somewhat shrouded in mystery, and in a widely varying manner. The Weeping Willow, believed by Linnaeus and other earlier authors to be from Babylonia, is now quite definitely known to be a species of Chinese origin, cultivated since ancient times in that country but still growing wild in some parts, and carried from the East to the West in early historical times by human efforts. The Lombardy Poplar, on the other hand, is a man-made tree, most probably a selected stock from the common Black Poplar in Europe, and originated about some three hundred years ago. Its origin forecasts the great emphasis on clonal selection as an important phase of poplar culture now so extensively practiced in both Europe and America.

The Willow Family

The Willow family is primarily restricted to the temperate regions of the Northern Hemisphere. It is readily distinguished from all other groups and constitutes the sole family of the order Salicales. The genus *Salix*, the willows, contains some 300 species and *Populus*, the poplars, some 40 species, but owing to frequent hybridization in nature, especially in the willows, their classification into species is an exceedingly difficult matter. Their identification is further complicated by the fact that the sexes of the trees are different, and their flowers usually appear before the leaves are developed.

The poplars can readily be distinguished from the willows, in addition to other technical characters, by their drooping male and female catkins, which in the willows are stiff and erect. The development of the catkins is associated with the fact that in the poplars, wind-pollination takes place while in the willows pollination is generally by insects.

The Japanese botanist Nakai, who proposed numerous new species, genera and families in his lifetime, once established a third genus *Chosenia*, referring to it a willow from Korea. This is *Salix bracteosa*, which differs from the other willows in its drooping male catkins, in its two almost free styles, and in its glandless flowers. Rehder (1940) and others have followed him in recognizing this anomalous species as representing a distinct genus. Extensive morphological studies made by Hjelmqvist (1948) and others show, however, that in spite of these more or less distinct characteristics, there exists a continuous series of transitions in other species that renders such a differentiation undesirable.

Uses

The willows and poplars have been useful to mankind since prehistoric times. The use of willows for making baskets and containers, probably among the first articles manufactured by man, contributed much to the advance of our early culture in the formative period, and to this day the growing of basket willows is still an important industry in some parts of the Northern Hemisphere. The bark of some species is used for tanning or dyeing. As shade trees, both willows and poplars are invaluable because of their hardiness and rapid growth. As ornamental trees, like many other tree species possessing innate beauty, the most attractive kinds are indispensable for certain schemes of landscape decoration. The trees are also widely planted for windbreaks or screens or as holders of the soil. A few species are utilized locally for timber or for making charcoal.

Diseases

One of the great advantages of growing willows and poplars is their rapid growth, but these fast growing trees are also prone to many diseases. Many species are susceptible to canker caused by bacteria, to canker and stem die-back caused by a number of fungi, and to certain leaf diseases caused by rusts. Susceptibility may be increased due to unsuitable growing conditions. Thus under certain unfavorable conditions, some of these diseases may wipe out an entire population.

Among the insect diseases, the more serious one is caused by the poplar or willow borer or

[1] We are indebted to Mr. Wm. Richard Carpenter for the cover illustration as well as Fig. 6, and to Dr. E. J. Schreiner for Figs. 4 and 5.

weevil, a beetle imported from Europe. This pest is causing extensive injuries, especially in the northeastern United States, to the basket willow industry and to many poplar and willow trees used for landscape planting.

The Cultivated Willows

Willows have been cultivated in Europe and Asia since time immemorial for basket, timber, or for shade. The European species are mostly wide-spread in their natural ranges, occurring all the way to Western, Central or sometimes even to Eastern Asia. The cultivation of some apparently dates from prehistorical times and it is impossible to ascertain the exact localities where the different species were first grown.

Among the species cultivated specially for basketry work are the Almond-leaved Willow, *Salix amygdalina,* The Common Osier, *Salix viminalis,* the Purple Osier, *Salix purpurea,* and a form of the White Willow, *Salix alba* var. *tristis.* The most valuable timber trees of the genus are the Crack Willow, *Salix fragilis* and White Willow, *S. alba.* Other species like Bay Willow, *S. pentandra,* Goat Willow, *S. caprea,* Gray Willow, *S. cinerea* and Creeping Willow, *S. repens* are cultivated mainly for ornament.

In Eastern Asia, the most widely cultivated species are the Weeping Willow, *S. babylonica* and *S. Matsudana,* the latter in more northern regions and in wet as well as dry localities. Other species are cultivated mostly in local areas.

Many of the European species were introduced into America in colonial times and quite a number of these have escaped into the wild in the eastern states and have become naturalized. The native American species did not begin to be cultivated until about the beginning of the eighteenth century. Among the better known and early grown species are Pussy Willow, *S. discolor,* and Silky Willow, *S. sericea* of the northeast, and Black Willow, *S. nigra* of wider range. The native Basket Willow, *S. petiolaris* is cultivated in the northeast for making baskets along with the introduced Osiers, *S. viminalis* and *S. purpurea.*

The Cultivated Poplars

Many species of poplars have been cultivated in the Old World since very ancient times. Of European and Western Asiatic origin are such common species as the White Poplar, *P. alba,* Gray Poplar, *P. canescens,* European Aspen, *P. tremula,* and Black Poplar, *P. nigra.* Of Eastern Asiatic origin are the Chinese White Poplar, *P. tomentosa* and Chinese Aspen, *P. adenophora.* Of African and Asiatic origin is *P. euphratica,* the original "Weeping Willow" of the ancient scripts.

Fig. 1. The Weeping Willow

The association of sadness with poplars seems to have originated early both in the East and the West. It probably alludes to the captivity of the children of Israel "by the rivers of Babylon." Lombardy Poplar is often used in graveyards in the place of cypress in some countries of Europe and the Near East. In China, the poplar has been considered since the most ancient times as one of the five official memorial trees, the one reserved for the graves of the common people.

The most commonly cultivated American species is the Cottonwood, *P. deltoides* of eastern North America. The tree is very variable and runs into many forms and varieties. In North America it was apparently first cultivated in the first half of the eighteenth century or earlier. It is now the most generally planted tree in the middle States. It was introduced into Europe around 1750, and the first description of it was published in 1755 by Duhamel, who extolled its value for the decoration of parks (Sargent 1896). In Europe, it is generally planted as a timber tree and is the most widely cultivated species of American poplars. There it hybridizes with the European Black Poplar, giving rise to numerous hybrid poplars known as *P.* × *canadensis,* widely used in reforestation work.

Among the more recent introductions from eastern Asia are some highly ornamental species. Some of these are wild, others have long been cultivated there and were first introduced into the West toward the latter part of the nineteenth century. Among the more notable is *P. Maximowiczii,* from northeastern Asia and Japan, a handsome poplar with striking bark and foliage. The bark of old trunks is gray and deeply fissured. The leaves are large, dark green on the upper surface and whitish on the lower. Another handsome species is *P. Simonii* from northern China, a tree with slender branches and rather small bright green leaves. There is a variety 'Fastigiata' of narrow pyramidal form with upright branches. (Fig. 3).

The Weeping Willow

The Weeping Willow, *S. babylonica,* has a confused history in the literature. The name "Willow of Babylon" was mistakenly bestowed on this tree, which is quite definitely of exclusively Chinese origin. The willows mentioned in Psalms growing by the rivers of Babylon are now known to be not willows at all but a poplar, *Populus euphratica.*

In China the Weeping Willow is a favorite garden tree and has been widely planted from time immemorial. It now occurs nearly all over the country, especially along the waters on alluvial areas. As it is extensively planted, it is difficult to tell the wild from the cultivated trees. In Western China, in the mountainous region on the upper reaches of the Yangtze River, it is apparently still growing wild, and there trees attaining to the largest size are to be found (Wilson 1920).

From the most ancient times, the Weeping Willow has been closely associated with the Chinese people, playing an integral part in their garden art, folklore, painting and literature. The slender twig swaying freely in the wind is compared in the traditional literature with a dancing figure, hence the common term "willow waist." The weaving branches also symbolize affection and attachment, and willows were at former times picked to give to a departing friend to signify unbroken friendship. The willow tree is an indispensable item in the rock garden, always planted by the side of the pond which usually is the main feature of the design. It is widely known in the West by the "willow pattern" porcelain which is to this day still quite popular.

The Weeping Willow does not grow well in colder countries especially in drier situations. The willow that takes its place in northern China, around Peking, for instance, is *S. Matsudana.* A pendulous form, especially planted for ornamental purposes, resembles closely the Weeping Willow in general appearance. Other local species are similarly used in Korea, Formosa and other areas in eastern Asia.

Dispersion of the Weeping Willow

The Weeping Willow was introduced from China into Japan in early times and is now commonly planted there in gardens and used also as a street tree. The tree cultivated there is the male form and from there it has also been introduced into California and commonly planted around San Francisco (Wilson 1920).

The spread of the Weeping Willow toward the West, into Central Asia, must have happened at a very early date but nothing is known definitely. Most probably it was carried westward by travelers along the overland "silk road" through the deserts, either deliberately or accidentally. As willow branches were used extensively in former times for weaving baskets, crates and for many other purposes as well, and as the twigs are easily rooted by mere insertion into the ground, incidental introduction and cultivation in many lands could have happened readily and repeatedly.

As mentioned above, the tree introduced into Japan is male while the one introduced into Europe is female. In China both male and female trees are common. The downy seeds, known as "willow downs," flying in the air in late spring, are a familiar sight in regions where willows are abundant and a frequent subject in poetry.

The Weeping Willow was not known in western Europe until around 1700, at a time when the direct sea route to China was already quite active. However, the first introduction of the tree seems not to have come by sea but indirectly from Western Asia, a fact which shows that the species must have been well established in Central and Western Asia at a much earlier date.

The Englishman James Petiver, in his work "Musei petivertiani centuriae. . ." published in 1703, mentioned that a specimen collected by Cunningham from China has pendulous branches and bears the Chinese name Yang-liu (Bretschneider 1882-1895). Cunningham went

Fig. 2. The Weeping Willow in early spring, Morris Arboretum.

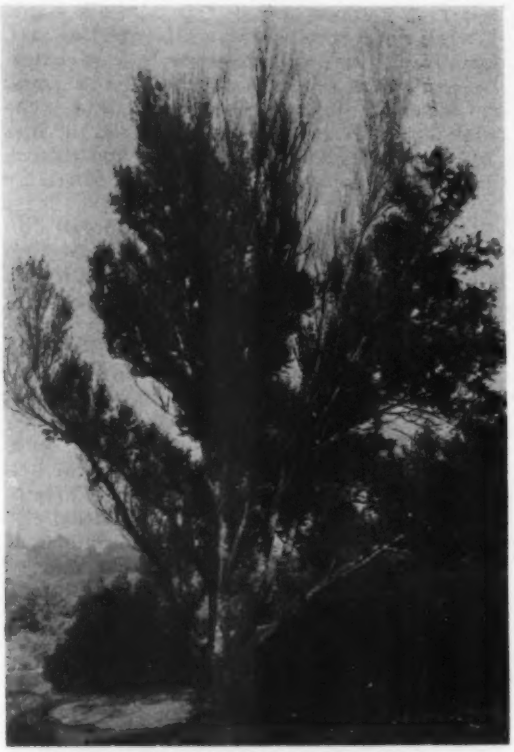

Fig. 3. *Populus Simonii* 'Fastigiata'.

to China by sea in 1698. This shows that the tree must have been unknown to England in cultivation at that time.

A later record of the tree is found in Tournefort's "Corolarium" of 1719, which describes the tree as the Oriental Willow, as found in the Levant. The tree must have been finally introduced into England sometime before 1730 for it was known to be on sale in gardens near London as stated in a catalogue published by Philip Miller in that year (Wilson 1920).

According to Wilson, since the Weeping Willows in Europe are female they are in all probability originated from a single tree introduced either by Tournefort or Wheeler from Western Asia. The latter mentions a tree which might have been a Weeping Willow in his book "Journey in Greece and Asia Minor" published in 1682, but this record is even more uncertain.

Although Wilson asserts that the tree was probably introduced into England indirectly from Western Asia, it seems also highly probable that it could have arrived directly from China by sea in the late fifteenth or early sixteenth centuries. The fact that all European trees are female makes Wilson's contention that they are all descendants of a single tree also feasible, but again more than one clone[2] might have been involved.

From Europe the Weeping Willow was carried to many other parts of the world including North and South America. It is not known when it was brought to the United States but Wilson thinks it was probably toward the end of the eighteenth century.

The most famous of these cultivatd trees is probably one of the many planted on St. Helena by Governor Beatson about 1810, one which became a favorite with Napoleon then in exile, under which he used to sit at length meditating on his past glories and vanities.

The Weeping Willow in Cultivation

The Weeping Willow, like other species of the family, is fast-growing but short-lived. It is widely cultivated for its distinct ornamental effect but aged or very large specimens are not common in cultivation. It is also not hardy in very cold climates.

The willows hybridize freely in nature. The female trees of the Weeping Willow, as cultivated in the West, have produced in the nineteenth century several hybrids or supposed hybrids with some other species, and these hybrids

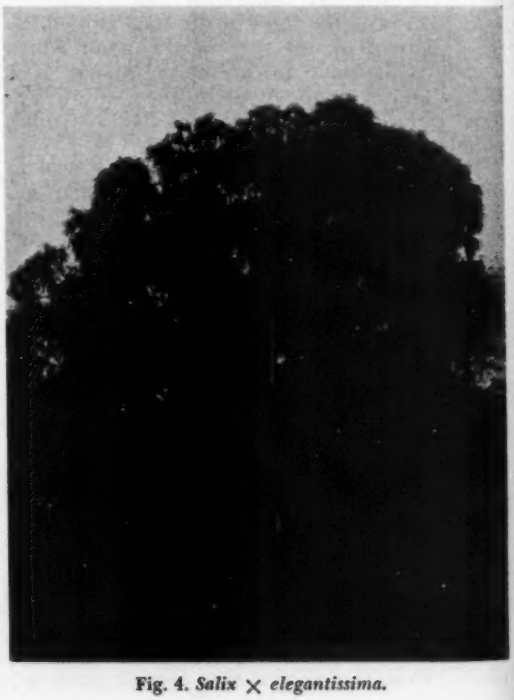

Fig. 4. *Salix* × *elegantissima.*

[2] The term "clone" is a technical one now used for all plants propagated vegetatively from a single individual.

Fig. 5. Poplar trees in the neighborhood of the town of Monoclaieri, Turin, Italy, after a water-color by Gieuseppe Pietro Bagetti, 1764-1831.

have since been maintained by vegetative propagation. These trees resemble somewhat the Weeping Willow in general appearance especially in the long hanging branches but are usually more hardy and are thus often planted where the Weeping Willow proves to be tender.

Two of these trees are supposed hybrids between the Weeping Willow and the Crack Willow, *Salix fragilis* of Europe and Western Asia. One of them is called *S.* × *elegantissima*, the Thurlow Weeping Willow, (Fig. 4) and the other *S.* × *blanda*, the so-called Wisconsin Weeping Willow. A third tree is a putative hybrid between the Weeping Willow and *S. alba*, the common White Willow of the Old World, and is named *S.* × *sepulcralis*.

The Origin of the Lombardy Poplar

The Lombardy Poplar, ever since it was first known, has been a problem to botanists and horticulturists. The tree, as compared with the Weeping Willow, has a much shorter history, as it apparently first appeared only some three hundred years ago, but its origin is even more mystifying than the Weeping Willow.

The Lombardy Poplar first originated as a cultivated tree in Europe. It was a tree unknown to the ancients. It was not recorded by Pliny, who certainly would have taken notice if it existed then.

The earliest cultivated trees seemed to come from northern Italy, where the Black Poplar is common, particularly in Lombardy, on the banks of the Po, hence the name Lombardy Poplar or Po Poplar. (Fig. 5). The Italians generally called the tree Cypress Poplar, Pioppo Cypresso, on account of its shape.

Manetti noted in 1836 as cited by Loudon (1838) that along the banks of the Po, there were Lombardy Poplars growing among the Black Poplar, *P. nigra*. As these appeared on exposed banks once overflowed, he believed the seeds were buried in the soil for many years and came from extinct forests. This seems hardly likely, and as noted by Loudon, it would be more plausible to consider these as seeds of the current year carried there by the wind. Manetti's letter, apparently a translation from the Italian, is the only reliable record of this tree made on the basis of first-hand observation at this early date. It was reprinted in the Gardener's Chronicle in 1883, but as the anonymous author notes therein, "it is very contradictory and vague in some parts."

The Lombardy Poplar is considered by some earlier authors as native to Persia and the Himalayan region and probably carried from there to Italy (Loudon, 1838; Anonymous, 1883), but there does not seem to be evidence to substantiate these views. Because of the fact that it was not introduced into Tuscany till 1805, Loudon believes that it is not indigenous to Lombardy or any part of Italy as he thinks it certainly could not escape the notice of the Roman agricultural writers.

All evidence seems to indicate that the Lombardy Poplar first made its appearance in the Po Valley of Italy. The enigma which confronted Loudon can be explained if we assume that it did not exist in ancient times, but appeared, some three hundred years ago, as mutants of the Black Poplar. Its remarkable shape accounts for its selection and cultivation by some enterprising farmers and its subsequent dispersion to other countries.

That the Lombardy Poplar is closely related to the Black Poplar was a fact very early noted by botanists. It was first considered by Munchhausen as *P. nigra* var. *italica* (1770); later as a

distinct species under such names as *P. italica* Moench 1785, *P. dilatata* Aiton 1789, *P. pyramidata* Moench 1785, and *P. fastigiata* Desfontaines 1804. However, the closeness of the two in vegetative as well as reproductive structures leaves little doubt that the Lombardy Poplar is, in spite of different growth form, only a variation of the common Black Poplar of Europe.

This seems to be the generally accepted view at the present. In a recent monograph on poplars by Hesmer (1951), it is called *P. nigra* var. *italica*. As this tree represents a form selected for cultivation, the modern terminology renders it as *P. nigra* cv. 'Italica' and it is so named in another recent monograph issued by the FAO (1956).

The Dispersion of the Lombardy Poplar

From Italy, the Lombardy Poplar was introduced into France in 1749 and at about the same time also into Germany (Loudon 1838). It was introduced into England at about 1758 from Turin (Aiton 1789). Since then it has been generally planted throughout Europe, either as a roadside or ornamental tree, or occasionally as a timber tree. The date of its introduction into America is given as 1784 by Sargent (1896). During the nineteenth century, the tree was taken to other parts of the world from Europe or America. It is now very commonly cultivated in Eastern Asia, as a street or shade tree or for reforestation purposes.

Fig. 6. Lombardy Poplars in New York State.

The Lombardy Poplar in Cultivation

The Lombardy Poplar is now one of the most widely planted trees around the world, but nearly all planted trees are male ones. (Fig. 6 and 7). Only a few female trees are known to exist, and these have less strictly upright branches and consequently forming a broader head. The occurrence of both male and female trees shows a number of clones are involved.

In cultivation, there is another fastigiate form of the Black Poplar, cv. 'Plantierensis', very similar in habit to the Lombardy Poplar but usually not so slender. This resembles closely the Lombardy Poplar and is generally also called by that name. It differs, however, in the hairy branches and leaf-stalks, and for this reason, it is supposed to be a cross between cv. 'Betulifolia', Dawny Black Poplar and the true Lombardy Poplar. This tree originated at Plantieres, in France, in about 1885 or earlier, and both male and female plants are known.

The main value of the Lombardy Poplar is ornamental. The distinct fastigiate shape is often exploited with admirable effect in landscaping to contrast with horizontal lines of architecture and with round-headed trees. It often fits in the landscape to balance horizontal lines like bridges or walls, or certain types of buildings. Its taller, pointed heads give contrast to the round heads of most other trees.

The Lombardy Poplar, like other species of poplars, is subject to many diseases. It is generally resistant to bacterial canker and seems to be fairly resistant to rust. However, the trees, especially the older ones, suffer rather violent die-back due to some as yet unknown cause. This die-back is fairly common in European trees and was especially prevalent some eighty years ago, but it is now of more frequent occurrence in North America.

This diseased condition was formerly believed by some as a decline in vigor due to clonal senescence (Focke 1883). But as the European trees are now in an apparently better condition than before the turn of the century, evidently this is not the case. More probably, in the Lombardy Poplar, a number of clones were actually represented, and as the more susceptible ones had been killed and eliminated, the surviving ones are among the more resistant.

The prevalence of this destructive disease makes this tree unpopular in North America. Attempts to introduce from Europe certain resistant clones should be made in order to revive the Lombardy Poplar populations in America.

Fig. 7. Lombardy Poplars along highway in Ontario, Canada (Canadian Government Travel Bureau photo).

Breeding and Selection of Poplars

In recent years, great efforts have been made in Europe as well as in the United States in the promotion of research and culture of poplars. The improvement of poplars is aimed especially at the production of fast-growing, disease-resistant strains. The technique includes primarily hybridization and clonal selection. (Pauley 1949, Schreiner).

The native species of poplars have been used for centuries in all parts of Europe. Hybrid poplar culture was first started there about 200 years ago when the American Cottonwood was introduced. Countless numbers of hybrids have since been produced by natural hybridization between the introduced American species and the native European Black Poplar, followed by back-crosses between the hybrids and the latter species.

Many of these hybrids or putative hybrids are superior to either one of the parental species in rate of growth, disease resistance, stem form or other desirable characteristics. As these poplars can be readily propagated by cuttings, superior individual trees can be selected and propagated.

The most important hybrid poplars are crosses between the American Cottonwood, *P. deltoides* and the European Black Poplar, *P. nigra,* known collectively as *P.* × *canadensis.* These hybrids were probably originated first in France before 1750, and there are now many different forms, named and unnamed, propagated as clones. These were originated independently in different places between the various forms of the two parent species.

The culture of poplars is now continued on a more scientific basis. Instead of selecting from spontaneous hybrids, controlled breeding is now performed and clones are selected and propagated from the resulted hybrids bearing desirable characteristics.

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The Pesticide Choice

PATRICIA ALLISON

The colorful conglomeration of chemicals at the garden store is easily one of the most bewildering sights to the conscientious gardener who has recognized that he has a pest problem and wants to do something about it. There he stands, ready to purchase the correct material so that he can apply it correctly, at the right time, and as often as necessary. But which of the many preparations before him is the correct material?

Lucky for him that his garden store does not stock all of the pesticides on the market, for the choice would seem even more difficult! For example, each year Dr. Donald Frear of Pennsylvania State University, an expert in the field, compiles a list of pesticide products. There are over 5000 listings of fungicides and insecticides alone! Is only one of these thousands "THE correct purchase" for the gardener standing before the shelves in the store? No. Many will do the job. Confusing as some of the names are, the problem of selection is not nearly as difficult as many believe. Let's consider first how there came to be so many products to choose from.

LIFE HISTORY OF A PESTICIDE

The modern pesticides perform modern "miracles" and are put on the market only after the expenditure of modern millions. These chemicals are designed to kill living organisms such as fungi, bacteria, insects and nematodes. But this is not all. They must do it without harming other living organisms, such as the plants harboring the pests, and such as the man wielding the spray gun. The attainment of these objectives is possible only through prolonged research. Furthermore, the claims made by the manufacturers on the labels are not merely claims. They are backed by research data and must satisfy the most careful scrutiny of government experts whose principal interest is the safe use of the material.

It is a long, long road from the gleam in the chemist's eye to the ring of the cash register. These are some of the sign posts along the way: After the first sample of new chemical has been synthesized and turned over to staff entomologists and pathologists, it is repeatedly tested in the laboratory against an assortment of pests. If found to be harmless to the plants, and if it once more controls the pests, additional testing must be undertaken. (By this time the eye-gleam has been transferred to the patent department). The additional tests involve first small, then large-scale fields experiments at many locations.

Before such a program can get underway, three new lines of investigation must be initiated. 1) Data must be collected concerning its possible harmful effects on mammals. 2) Ways must be found to manufacture the chemical in larger test quantities. 3) Ways must be found to formulate the chemical effectively.

Mammalian toxicity tests are expensive, time-consuming procedures to gain essential information about the safety of the potential pesticide to the users and other beneficial animals. The effects on animals of large single doses and of small doses supplied over a long period are studied.

The development of ways to make larger batches of the candidate pesticide results from the combined ingenuity of chemists, chemical engineers, and cost experts.

The third line of investigation is equally important and has direct bearing on your choice of material from the shelf at the garden store. Up to this point we have been talking about a relatively pure chemical—quite unlike the products you buy. The investigators have had to use special techniques in applying the material to plants. Now that the chemical shows such promise, ways must be found to put this active ingredient into such form that it can be marketed and can be taken from the package and put to use easily by the purchaser.

Active ingredients are very potent. In actual use, only minute quantities are applied to each plant. There must be some means to assure that this small quantity is evenly distributed. This is accomplished by dilution with some other material so that the combined bulk can be handled conveniently and accurately. This is called formulating, and the products you buy are *formulations of active ingredients.* With *spray* formulations most of the diluting of the active ingredient is done by the consumer when he adds water. With *dust* formulations the dilution is with some dry, non-caking powder, and is done by the manufacturer. Thus the consumer buys a greater bulk of "inert" ingredients when he buys dusts than when he buys spray materials. The "inert" materials in spray formulations consist of small amounts of wetting agents, stickers, and other materials that help make an acceptable final suspension of the active ingredient when water is added. You can buy spray formulations as dry

"wettable powders" or as liquid "emulsifiable concentrates." Dust formulations may also contain small quantities of various compounds so that they will have the correct properties for most effective performance of the active ingredient at the plant surface.

In the development of a new pesticide, all of the trial formulations must be carefully tested to be sure that the potency of the active ingredient has not been diminished by combining it with other compounds. When satisfactory ones are found, the field testing really begins. This may take several years, and is performed largely by state and federal agencies under carefully controlled conditions. If the pesticide still looks good, the federal government may approve its commercial use for specific crops. Approval is given only after careful examination of data concerning its effectiveness and safety. Even then testing is not complete. Whether or not the pesticide can be combined with other pesticides is very important. New fungicides, for example, must be compatible with many of the insecticides in use, so that both types of materials can be applied at the same time. Sometimes the grower mixes the pesticides himself; sometimes they are already combined by the manufacturer.

You may have guessed by now that those 5000 listings of pesticides are not listings of 5000 different active ingredients at all. They are various formulations and combinations of a relatively few potent chemicals made up for sale by a large number of companies under an even larger number of brand names. For this reason alone it becomes imperative to read the labels before buying, and to distinguish between brand names and active ingredient names. You can rest assured that the brand names are going to be in big, colorful letters, and that the active ingredients are listed at the bottom somewhere in fine print. The size of the letters is made up for by the size of the words, however. For example, a common ingredient is 2,2-bis (p-methoxyphenyl) 1,1,1-trichloroethane. Another is N-trichloromethylmercapto-4-cyclohexene-1, 2 - dicarboximide. Pretty terrible. Because these chemical names are so unwieldy for easy use even among entomologists, "coined names," referring to specific active ingredients such as the examples above, have been approved. The coined names for the insecticide and fungicide just mentioned are methoxychlor and captan, respectively. They are much easier to remember and their use in recommendations for pest control does not imply the use of any particular brand. The books listed below will tell you exactly what the chemical names are that correspond to the coined names. Most labels now list coined names.

General Categories of Pesticides

The most fundamental characteristic on which to base a grouping of the many garden pesticides available to you is, of course, their killing power. Thus there are insecticides, miticides, fungicides, bactericides, and nematocides, all named after their victims. The insecticides have little or no fungicidal activity, and vice versa. Furthermore, there are various combinations of these basic types of active ingredients. Mixtures containing several insecticides or insecticides and miticides are common. Some "all purpose" formulations contain one or more insecticides, a miticide, and a fungicide or two. Your choice of material will depend in large part on the extent of your knowledge of what pest problems you are likely to encounter in your garden. You should be fully prepared to wage war before the growing season begins. If you are not sure that you will be able to distinguish fungus difficulties from insect damage, the best move would be to get a good all-purpose preparation. If you can distinguish the two, investing in a combination insecticide-miticide, and a good fungicide would be better, as you are likely to need the insecticide more often than the fungicide on most plants (Roses not included!). If you are becoming skillful in differentiating insect from mite or red spider damage, purchasing separate preparations for them could be advised. Many gardeners find that a good bit of their fun is derived from mixing their own combinations. Dr. A. W. Dimock of Cornell recommends a good homemix, that would be superior to most ready made preparations.

The pesticides at the garden store can be further classified on the basis of type of formulation. Here again, many of the preparations can be eliminated from consideration after you make a single decision. That decision is whether to spray or to dust. There are advantages to each. Assuming that the job is done regularly, the spray job is better. Spraying involves a capital investment in applicator somewhat above that for a duster. It also involves mixing up the pesticides to begin with and cleaning the apparatus after use. But the sprayer is much more versatile than the duster from three important standpoints. 1) You can make your own mixes, omitting some ingredients when they are not necessary. 2) Some plants require ingredients that others do not. It is a simple matter to mix a tankful for them. This allows you to take advantage of the specific recommendations written up especially for you in garden reference books. 3) Spray from a good sprayer can reach parts of plants inaccessible with a duster. (Extra dividend to spraying: Pumping up a sprayer will

help that waist-line.) Dusting, on the other hand, might be more convenient from the application standpoint and thus lead to more regular application. Cost of the pesticides during the season will be higher, and considerable care must be taken to avoid windy periods for applying the dusts. Also emptying and refilling a duster can be messy.

There is a third group of materials, the so-called all purpose "spray *or* dust" mixtures. It stands to reason that when the active ingredients have been diluted enough by a dry carrier to use as a dust, you will have to use a relatively large amount in making up a spray. When this is done the treated plants are apt to be unsightly with the accumulated carrier applied wet. Zineb, for example, one of the best all-around fungicides, is supplied as a 65 per cent wettable powder for spray use. One tablespoon per gallon of water is sufficient. When formulated as a dust, commonly a concentration of 6.5 per cent in the dry carrier is puffed onto the plants. Now, if this same concentration is in a "spray or dust" mixture, you must use 10 tablespoons per gallon of water! It's better to use mixtures designed especially for spray use.

There are three other categories of garden pesticides that should be mentioned. One is the group of formulations now available to you for control of insects in the soil. Take advantage of the opportunities to control grubs, ants, chinch bugs, cutworms and the like. Another group of preparations is for use as seed treatments. In general, small seedlings are much more susceptible to killing by certain soil fungi than are mature plants. A small packet of one of these powders will treat hundreds of seeds.

The third category of pesticides is one that should interest you right now. These are the potent "dormant" sprays and dusts. They are compounds such as lime-sulfur, oils, and dinitro chemicals that can be applied at high concentration to plants before the buds have broken, but must be used at low concentration or not at all after foliage is exposed. This dormant spray can be an extremely important event in your garden schedule, because some of the most serious insect pests, as scales, mites, and aphids can be much reduced in number as a result of this one application. Lime-sulfur and the dinitro compounds also help to reduce the amounts of some fungi that have overwintered on twigs and buds. The dormant sprays should be applied on a day when the temperature will be no lower than 40 to 45 degrees. If you use lime-sulfur, don't forget that spray drift will ruin white paint.

While you're thinking about mobilizing your forces, take a tour of your favorite supply store and ask to see the sprayers and dusters. While you're there you can practice your label reading.

Look for:

1) Whether spray or dust.
2) Name of active ingredient and concentration. Do not buy if this is not present.
3) List of pests it will control.
4) Names of plants the chemical might harm.
5) Instructions for use. Some chemicals, as sulfur may be harmful in very hot weather. Others may be inactive or harmful in cool weather.
6) Safety precautions.

Now is also the time to purchase a book on garden troubles. Three of the best are listed below. They are recent enough to contain discussions of most of the new pesticides. In them you will find explicit recommendations for particular troubles, and helpful suggestions for all around protection. After a session with your new source of help, make a second trip to the store, stock up on the ammunition you will need, and plan your attack!

DIMOCK, A. W. 1953. *The Gardener's ABC of Pest and Disease.* 191 pp. M. Barrows and Company, Inc., 425 Fourth Avenue, New York 16, N. Y.

PIRONE, P. P. 1952. *Modern Gardening.* 371 pp. Simon and Schuster, 630 Fifth Avenue, New York 20, N. Y.

WESTCOTT, CYNTHIA 1953. *Garden Enemies.* 261 pp. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York 3, N.Y.

Local Chapter of Rhododendron Society

The Arboretum is happy to announce the organization of a Philadelphia Chapter of the American Rhododendron Society. The President of the new Chapter, Mrs. William Kelius of Levittown, realized the need for a more centrally located meeting place for the many Rhododendron enthusiasts in the Philadelphia area, and it is largely due to her efforts and keen interest that the Chapter was organized.

Seventeen people attended the first meeting held in December, and since that time the membership has increased to 51. The group will continue to meet at the Arboretum at 8:00 P.M. the second Thursday of the months of April, May, and June. Meetings will not be held during the summer months but in September the Arboretum will again serve as the meeting place for this rapidly growing group.

The Chapter will arrange monthly programs to include talks by several Rhododendron authorities and field trips will be made to some of the private gardens in the area. For more extensive field trips, the Chapter will cooperate with the very active Middle Atlantic Chapter of the American Society.

Annual dues, which include free attendance at the monthly meetings plus receipt of the Quarterly Bulletin of the American Society, is $5.00. Those who are members of the American Society and are not affiliated with a local chapter may join the Philadelphia Chapter simply by indicating their intention to the American Society headquarters in Portland. Those who are now members of a local chapter may join the Philadelphia Chapter by paying $1.50 dues and still retain full membership in any other local chapter.

Persons interested in joining the Philadelphia Chapter may communicate with Miss Mary Milton, Secretary, at the Morris Arboretum, or Mrs. William Kelius, 67 Spineythorn Road, Levittown, Pennsylvania.

M. M.

Arboretum Activities

(Continued from Page 2)

mitted a list of persons who it was believed would like to be affiliated with the work of the Arboretum. At the same time it was decided to create four classes of memberships with annual dues ranging from $5.00 to $100.00.

Special invitations were printed and circulated among the lists of names submitted by members of the Council, as well as by members of our own staff. The results of this rather modest "campaign" have been most gratifying, as is evidenced by the fact that early in February of this year we passed the 500 mark!

The benefits of membership are several: Our Associates receive the quarterly Bulletin free of charge and are entitled to purchase other publications at a reduced cost; they enjoy full library privileges with the freedom to borrow books and periodicals; they may receive expert advice and assistance with their horticulture problems; they are invited to attend lectures and other events scheduled at the Arboretum; and they participate in the annual distribution of unusual trees and shrubs.

If any of our readers have friends who they feel would be interested in becoming Associates, we shall be grateful if they will bring their names to our attention.

Seed Exchange

One of the ways by which the arboreta and botanical gardens of the world help to build up each other's living collections is through an exchange of seeds. If institutions are near enough and transportation problems are simple, they may also exchange bulbs, scions, rooted cuttings and entire plants, but packets of seeds are by far the most effective medium of exchange.

Each Autumn members of the Arboretum staff devote many hours to the collection of seeds of trees and shrubs which we believe will be of interest to other institutions throughout the world. Consideration is also given to the native woody flora. For example, last September Mr. Richard B. Chillas, Jr., one of our Associates, made many trips throughout southern New Jersey and southeastern Pennsylvania, collecting seeds of wild trees, shrubs and woody vines to supplement the Arboretum's series of rare and interesting exotic species.

By November our carefully selected list of available seeds was ready for distribution to a mailing list which includes 39 domestic and 126 foreign gardens and arboreta. To date we have received requests for seeds from 9 institutions in this country and 41 from those abroad.

At the same time that we are filling orders for our own seeds, we are scrutinizing the seed lists sent to us by other arboreta and are submitting our "desiderata" to them. At this season nearly every mail brings from all over the world packets of seeds of plants which will eventually enrich the collections of the Morris Arboretum.

Flower Show Exhibit

Upon invitation of the Pennsylvania Horticultural Society, the Morris Arboretum prepared an Exhibit of Medicinal Plants for display in the Philadelphia Flower Show which was held during the week of March 10. This exhibit took the form of a small garden containing nearly 70 species of plants used as drugs in various countries.

In addition to a number of familiar species, such as digitalis, quinine, nux-vomica, ephedra, etc., which are officially recognized in the United States Pharmacopeia, there were included many plants regarded as important sources of drugs in such regions as India, China, Africa, Mexico and tropical America.

Fig. 8.

Fig. 9.

Each plant was accompanied by an attractively prepared label giving its common name as well as a number which enabled it to be indentified on a key containing information concerning its value in medicine.

Although not in competition, this exhibit was given the Award of Merit of the Garden Club Federation of Pennsylvania. (Figs. 8 and 9).[1]

All of these plants, and many others which for want of space could not be included, will be displayed in the Arboretums' outdoor Medicinal Plant Garden which will be opened to the public during the summer of 1958.

As previously reported in these pages this garden is being made possible through the Founder's Fund Award of the Garden Club of America.

J.M.F., Jr.

[1] Illustrations by Edmund B. Gilchrist, Jr.

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